CALCULUS.

232. Proposed by PROF. R. D. CARMICHAEL, Anniston, Ala.

Evaluate (a) $\int_0^{\frac{1}{2}\pi}\frac{\sin nx}{\sin x}dx$, and (b) $\int_0^{\frac{1}{2}\pi}\frac{\sin^2 nx}{\sin x}dx$, where n is a positive integer.

233. Proposed by W. J. GREENSTREET, M. A., Editor of the Mathematical Gazette, Stroud, England.

Prove that $\int_0^{\infty}\frac{a^{-1}dx}{1+2x\cos\theta+x^2}=\frac{\pi\sin(1-a)\theta}{\sin a\pi\,\sin\theta}$

MECHANICS.

196. Proposed by W. J. GREENSTREET, M. A., Editor of The Mathematical Gazette, Stroud, England.

From a uniform, solid right circular cone two planes cut off a portion such that the sections are similar ellipses with co-planar axes (not parallel). The centers of the elliptic faces are O_1, O_2, and the center of gravity of the solid is G. GX parallel to O_1O_2 cuts the axis of the cone in X. Find GX/O_1O_2 in terms of the ratio of the major axes of the ellipses.

197. Proposed by WALTER D. LAMBERT, 416 B Street N. E., Washington, D. C.

Suppose that a primary planet and its satellite revolve with uniform angular velocity in circular orbits in the same plane. What relation must hold between the radii of their orbits and their angular velocities in order that the curve traced by the satellite shall be everywhere concave to the sun? Apply to the earth-moon system to prove that the moon's path is always concave to the sun.

DIOPHANTINE ANALYSIS.

142. Proposed by DR. L. E. DICKSON, The University of Chicago.*

Let n be an integer >1 and set $p=n(n-1)+1$. Required n integers whose $n(n-1)$ differences are congruent (modulo p) to the numbers 1, 2, ..., $p-1$. Exhibit at least for $n=3$, 4, 5, all inequivalent sets of solutions where a set a_1, a_2, ..., a_n is called equivalent to the set $m(a_1-d)$, $m(a_2-d)$, ..., $m(a_n-d)$, for any integers m and d (m not divisible by p).

143. Proposed by JOHN D. WILLIAMS (being the first of his 14 challenge problems proposed in 1832).

Make $x^2+y^2=a^2=z^2+w^2$ and $x^2-w^2=z^2-y^2=\square$.

144. Proposed by JOHN D. WILLIAMS (being the ninth of his 14 challenge problems proposed in 1832).

Make $(m^2+n^2)^2x^2\pm(m^2+n^2)x=\square$, $(m^2-n^2)^2x^2\pm(m^2-n^2)x=\square$, and $4m^2n^2x^2\pm2mnx=\square$.

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*See problem 132, Diophantine Analysis, proposed by Dr. Veblen, and its discussion on page 215 by Dr. Safford.